ON THE BIOLOGY AND MORPHOLOGY OF EPIPYROPS EURYBRACHYDIS FLETCHER (LEPIDOPTERA).

(An External Parasite of Eurybrachys tomentosa Fb.: Fulgoridae, Rhynchota).

BY

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(With one plate and a block).

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Nearly 50 per cent of the adult females of Eurybrachys tomentosa collected from species of Acacia, for life-history work were found parasitised by one stage or other of the larva of Epipyrops eurybrachydis (Zygaenoidea—Lepid.). The larva was usually found underneath one of the wings of the host, holding fast to the abdominal terga, by means of the prolegs, with the head pointing posteriorly and the mouth-parts buried in the soft fatty tissue, close by the tip of the abdomen, which is covered profusely with white cottony wax, so characteristic of the female Eurybrachys tomentosa (Plate 1 a). The presence of the larva is always indicated by the raised position of the tegmen and the wing of one side. When the larva is only partially grown the extent to which the wing is raised is not so marked as when it is between the third and fifth instars. The fulgorid parasitised by a full-grown larva can be spotted out in its natural environment even from a distance of a few yards.

The Egg.—Each egg is about .5 mm. in length and dirty golden-yellow in colour; oval in shape. The apical end is broader and almost flat, showing a dark ring. The surface of the chorion is granular and sparsely covered with minute strands of whitish meal (Plate 2, fig. 3).

The egg hatches in 6-8 days after being laid. The larva emerges by bursting open a circular lid at the apical end of the egg.

The First Instar Caterpillar.

Length—about 1.25 mm. Body is tapering towards the posterior extremity. Head is triangular; antennae 3-jointed, the apical joint bearing minute papillae and two long sensory bristles; ocelli are six in number, circular and situated on the epicarnial plates; mandibles well developed with two pointed teeth each; maxillae long, cylindrical and three-jointed, the apical joint having minute sharp spines. The spinneret is also well developed.

Thorax.—The tergum of the prothorax is lightly chitinised and appears like a brown cross band behind the head; three sizes of minute sharply-pointed setae, apart from the more minute ones with which the body cuticle is profusely covered, are noticeable; there is a pair of prothoracic spiracles situated almost intersegmentally and a pair of stout, five-jointed legs terminating in a single curved chitinous claw, is present (Plate 2, fig. 7).

The meso and metathorax are devoid of any brown band on the terga; in addition to the sets of minute setae, noticed in the prothorax, there is seen, mostly across the middle of the ventra a row of short slightly capitate setae; two hind pairs of thoracic legs are present; spiracles are absent (Plate 2, fig. 8).

Abdomen.—There are ten abdominal segments; they are narrower towards the tip; the segments 5-6-7 bear a pair of prolegs each; the pair of the tenth segment is comparatively long and has three pairs each, of curved and sharp crochets, which are the claspers (Plate 2, fig. 9); the other prolegs are short and stumpy and bear 5-6 crochets each (Plate 2, fig. 8); the capitate setae are present on most of the abdominal ventra; the first seven segments bear a pair of spiracles each,
The posterior extremity (7-10 segments) is tinged bluish-green. The spiracle (Plate 2, fig. 10) is of a typically lepidopterous larval kind; circular-oval, with the tips of the opening fringed with very minute, branched hairs.

The further instars of the caterpillar (2nd. to 5th. instars).

The points of difference between the first and the subsequent instars are:

1. Marked increase in size; the full grown caterpillar measuring about 7-8 mm. long and 3-4 mm. broad at the middle.
2. The capitate setae present on some of the thoracic and abdominal segments of the first instar caterpillar are not seen.
3. Body cuticle gets much folded in 4th. and 5th. instars, so that the segmental lines are slightly obscured.
4. The wax pores (Plate 2, fig. 8) are seen in the 5 instar arranged in the first, second, third, ninth and tenth abdominal segments—a pair in each.
5. True claspers are not present, the last pair of prolegs being very short and stumpy as the others.
6. The number of crochets of prolegs increases towards the later instars and the full-grown caterpillar bears 35-38 crochets, approximating in arrangement, to the transverse uniserial type (Plate 2, fig. 12).
7. In the caterpillars of the later instars, the crochets of the posterior row are slightly longer (Plate 4, fig. 14).
8. The anal prolegs have only the anterior row of crochets.

Ecdysis of caterpillar.—For about 48 hours before the process begins, the caterpillar is quite still and does not feed. The process is undergone either on the body of the host under cover of the wings (in the later instars); or outside among the leaves (in the first instar); the caterpillar assumes a semi-doubled-up position and is fixed to the surface by means of sucker feet; later, a slit appears along the mid-ventral line from the head down to the tip of the abdomen and the emerging caterpillar slowly creeps out by a steady peristaltic movement caused by the surging of the body fluid combined with a series of contractions and relaxations of the segmental muscles; the original cuticle is gradually pushed behind, dry and much wrinkled. The whole process takes about 10-12 hours.

A. A young caterpillar sticking to the left of the abdomen of the host Fulgorid Eurybrachys tomentosa.
B. 1. Full-grown caterpillar.
   2. Same covered over with white cottony silk.
   3. Pupa protruding out of the cocoon.
   4. Adult moth.
C. Egg-mass of Epipyrops eurybrachidis,
Ecdysis occurs altogether four times, there being five instars of the caterpillar during the prepupal stage.

The full-grown caterpillar.—Length 7-8 mm. Width 3-4 mm. The head is largely oval and highly chitinised. The epicranial plates are wide and triangular, each bearing six circular ocelli near the antero-lateral margin. Above the ocelli, is the pair of three-jointed antennae.

Between the epicranial plates are the frons and the clypeus; the frons extending as far downwards as the inner posterior margins of the epicranial plates (epicranial suture), the adfrontals generally present in a lepidopterous larva, not being differentiated here. The median epicranial suture is not very prominent (Plate 2, fig. 4).

The mouth-parts of the caterpillar (fig. 5) consist of a labrum (fig. 11), a pair of mandibles, a pair of maxillae and a specialised labium with spinneret.

Mandibles are long, well developed, each having a pair of sharply-pointed teeth, which, sometimes overlap. They work like a pair of shears as in the case of mandibles of certain epidermis-feeding larvae. The sharp teeth are also pierced into the soft fatty portions of the host's body and thus the imbuing of minute quantities of the body juices is helped.

Maxillae are more or less vestigial and consist only of a broadly-cylindrical cardo and a small cuboid stipes, bearing a two-jointed palp, the tip of which is provided with sharply pointed spines. The vestiges of lacinea and galea are probably represented by the two small conical structures attached to the stipes at the outer margin. There is also present a maxillary lobe at the distal extremity consisting of a broad base with 3-4 pointed papilla-like structures (Plate 2, fig. 6).

Labium is situated on the ventral region of the head between the maxillae; it is a single, wide, lightly-chitinised structure; the submentum, mentum and prementum of a typical labium are not clearly differentiated here; the region of the submentum is broad and that of the prementum, narrow. Proximally is a long cylindrical, chitinous, median, perforated process, the spinneret hinged on to a semi-circular, chitinous framework.

Food of the caterpillar.

Fletcher (Proceedings of the Third Entomological Meeting, Pusa, 1919, p. 979) has hinted that 'the larva probably sucks the juices of its host'. The observation made by the writer in regard to the feeding habits of the larva, and the structural features of the mouth-parts, largely confirm that view. Several caterpillars have been noticed to feed on the soft, fatty tissues of the body of the host, specially in the neighbourhood of the lateral margins of the abdomen and also on the soft membranous parts between the pronotum, scutum, and scutellum of the thorax. Many young caterpillars have been observed to scrape the surface of the hind margin of the tegmen of the host, in the same manner in which some caterpillars of other families scrape the epidermis of leaves, so as to leave behind only the veins; the scraped patches are to be easily distinguished from the non-scraped ones in the immediate neighbourhood. The young caterpillars have also been noted in the act of cutting the minute strands of cottony wax on the posterior margin of the abdomen of the host, perhaps, preparatory to scratching the tissue there. This sort of cutting of the cottony wax is often likely to mislead one to suppose that the caterpillar feeds on the stuff; dissecting out the digestive system of a caterpillar apparently feeding on the wax, did not reveal any of the material inside.

Some habits of the caterpillar.

The first instar caterpillar, wanders about a lot among the leaves and young twigs of the plant on which the eggs are deposited by the female moth, before it finally gets on to the body of the host Eurybrachys; a few of them have been observed to be in an upright position, clinging to the edges of leaves by means of the claspers and keep oscillating in the manner of a Geometrid larva, or a leech, presumably waiting for the host bug to pass by, in order to climb on to the latter's body. Successful finding of the host under natural conditions, before establishing there, appears to be largely a matter of chance, primarily because of the very minute size of the first instar caterpillar. In one case where 400 first instar caterpillars and half a dozen
adult host bugs were present on the leaves and the twigs of a small Acacia plant in a pot, only one host bug was observed after 5 days to have been infested with three caterpillars; most of the others had died by that time. Very probably, in nature, only a very few succeed in getting on to their hosts and the majority die away; the large number of eggs laid by the female moth clearly bears out this fact; the parent makes ample provision for risks.

There appears to be no doubt, that the adult female—Eurybrachys, alone—is preferred as host, to either the male adult or the several nymphal stages of the bug. The writer has not come across a Eurybrachys nymph nor a male adult harbouring the caterpillar. Numerous female adults have been obtained infested with caterpillars of all stages of growth from the second to fifth in different situations on the body. The last three instars have usually been found hidden beneath the wings, on one or both sides of the mid-dorsal line, with the head end pointing towards the posterior extremity, sticking fast to the surface by means of the prolegs and with mandibles buried into the fatty portions of the abdomen. The younger stages have been noted to be wandering on to the ventral surface as well as the tegmen, whose surface they go on scratching specially at the margins.

The duration of the larval period—6-6½ weeks is generally well within the life-span of the adult host. Six to seven days after the final moult the caterpillar leaves the host and selecting a suitable place on the undersurface of a twig begins to spin a cocoon round itself and then pupates. The host, dying prematurely, the caterpillar, not yet full-grown, also gradually dies away; for, the latter, does not thrive with feeding on the dead remains of the former.

The effect of the larva on the host-bug is sometimes apparent in the slow and only occasional movements of the latter (also due, in some instances, to a gravid condition). That the larva is of the nature of an external parasite of the fulgorid (somewhat like the external acarine parasites of domestic animals) there cannot be any doubt, judged specially from the habits of the former; but it cannot be anything more than a feeble external parasite. The normal life-span of the fulgorid host does not seem to be shortened by any marked degree, nor the egg laying capacity, by the parasitic habits of the larva. Two sets of female Eurybrachys, one with the larva, the other without, kept under observation under exactly similar conditions in the laboratory lived for about 7 weeks and oviposited thrice, there being 80-90 eggs each time in separate clusters covered over by white cottony meal. More than four larvae of different stages of growth have been observed on the same individual host.

Cocoon-Spinning.—The caterpillar first stations itself firmly on the surface on which the cocoon is to be spun by means of the sucker-feet. Then begins a series of back and forth and up and down movements of the head and the thorax; the spinneret situated on the ventral surface of the head, sends forth a continuous stream of tough white silk; the latter is woven, as a result of the series of movements, into a cocoon, layer over layer. The whole process occupies about three hours.

The Cocoon is of milk-white cottony silk, oval in shape and has a flat bottom by which it is firmly stuck on to the undersurface of twigs and a semi-dome-like upper. The surface is smooth except for a few shallow furrows and short blunt elevations 2-5 in number, usually along the upper middle line and rarely one or two on a side.

The Pupa is of a dark blue colour and varies in size with the sex of the adult moth into which it is transformed. The antennal and wing cases are very clearly marked, as also the region of the compound eyes of the future moth. The abdominal portion of the pupa, is pale blue and less heavily chitinised than the head and thoracic portions. Five pairs of spiracular openings are also clear on the first five abdominal segments. The abdomen has a small anal slit and two papillae (Plate 2, fig. 19).

Eclosion of the moth.—Through a transverse slit, at one end and at the point of contact, of the cocoon with the surface of the twig, the anterior heavily chitinised part of the pupa is thrust outwards and upwards; next a longitudinal slit along the mid-ventral line of the extruded portion forms the exit for the moth. With the head inside the anteriormost portion of the extended part of the pupa, acting as a pivot, the thorax, first and the abdomen,
next, are slowly drawn out; the wings and legs also appear at about the same
time and gradually unfurl and straighten themselves. In this condition the
moth rests for some time; finally the head is extricated; with the whole body
thus entirely out of the pupa, the moth rests for a second time before active
movement.

The Adult moth (Plate 1 b).—Epipyrops eurybrachydis is one of ‘the three
most commonly-occurring species of the only Indian genus Epipyrops, of the
family Epipyropidae under the super family Zygaenoidea’ (Fletcher, Proceedings
of the Third Entomological Meeting, Pusa 1919, vol. iii, p. 979).

There appears to be a marked variation in size of the different individuals
of the same species, apart from the difference in size between the male and
female, the latter being on the whole slightly larger.

The head is circular-oval, consisting of a narrow epicranium, a wide, deeply-
sculptured fronto-clypeus occupying the greater portion and the labrum. The
compound eyes are large and round.

The antenna is long, 14-16 jointed (14 joints in the male and 16 in the
female as a rule) each joint having a pair of different sized lateral branches
which again branch into a large number of small setae, the whole presenting
the appearance of a plumose structure.

In addition to the setae, the lateral branches have a number of sensory
pits lined with extremely delicate sensillae.

A true proboscis is absent; very probably, in nature, the moth does not
feed; in the laboratory, however, it was attracted by dilute honey and appeared
to imbibe it in extremely small quantities. Labial palps are highly vestigial.

Wings are well developed and their expanse is greater in the female than
in the male. The moths are capable of a low jerky flight. In the natural
position the wings are held in a steeply-sloping manner, while the body
is also similarly poised; the head being farthest upwards from the surface and
the first pair of legs extended. The hind part of the body is usually completely
hidden.

The legs are long and slender.

The abdomen is stouter in the female than in the male. Seven abdominal
segments are clearly visible.

Under laboratory conditions several moths lived from 8 to 10 days and
the female began to oviposit 24-36 hours after emergence. Each female laid
not less than 400-500 eggs, stuck on the leaves and twigs of Acacia sp. one
of the host plants of the fulgorid. The eggs are laid in groups of irregular
rows (Plate 1, c).

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Detailed Explanation of Plate.

Fig. 1.—Head of an adult moth.
1. Antenna. 2. Epicranium. 3. Fronto-clypeus. 4. Compound eye. 5.
Labrum. 6. Epipharynx.

Fig. 2.—Portion of antenna of adult moth.

Fig. 3.—Egg.

Fig. 4.—Head of caterpillar. Dorsal view,

Fig. 5.—Head of caterpillar. Ventral view.

Fig. 6.—Maxilla of caterpillar.

Fig. 7.—Prothorax of caterpillar. Ventral.

Fig. 8.—Abdominal segment of caterpillar. Ventral.

Fig. 9.—Claspers of first instar caterpillar.

Fig. 10.—Spiracle.
1. Sensory hairs lining the opening. 2. Elastic fibre to open the spiracle.

Fig. 11.—Labrum of caterpillar.

Fig. 12.—Crochets of abdominal leg.
1. Anterior crochets. 2. Posterior crochets.

Fig. 13.—Pupa.

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